Lightest Higgs boson masses in the R-parity violating supersymmetry

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The first results on the searches of the Higgs boson appeared this Summer from the LHC and Tevatron groups, and has been recently backed up by the ATLAS and CMS experiments taking data at CERN's LHC. Even though the excitement that this particle has been detected is still premature, the new data constrain the mass of the lightest Higgs boson m_{h^0} to a very narrow 120–140 GeV region with a possible peak at approximately 125 GeV.

In this communication we shortly present the Higgs sector in a minimal supergravity model with broken R-parity. Imposing the constraint on m_{h^0} we show that there is a relatively large set of free parameters of the model, for which that constraint is fulfilled. We indetify also points which result in the lightest Higgs boson mass being approximately 125 GeV. Also the dependence on the magnitude of the R–parity admixture to the model is discussed.

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I. INTRODUCTION

The Standard Model and most of its supersymmetric extensions suffer from being a theory of massless particles. Therefore a mechanism that would provide masses is required. Among several possibilities the Higgs mechanism plays a major role. It assumes the existence of an additional scalar field, the Higgs field, which has non-zero vacuum expectation value (vev). The correct implementation of this mechanism leads in the Standard Model not only to massive gauge bosons (with the photon correctly remaining massless), but also to massive fermions, and a proper electroweak symmetry breaking from the weak gauge groups $SU(2)_L \times U(1)_Y$ to the electromagnetism $U(1)_q$. These features make this mechanism an extremely convenient and elegant solution. The experimental smoking gun confirming this theory would be the discovery of the Higgs boson.

Earlier this year the Tevatron collaborations CDF and D0 reported an excess of events in the Higgs to two photons channel ($H \to \gamma\gamma$) observed in the mass region 120–140 Gev [1]. The significance of these data were reported on the level of 2.5σ. Only recently the newly announced LHC–7 results [2] from the ATLAS and CMS Collaborations confirmed an excess of events in the same channel within 115–130 GeV range, with a maximum at 125 GeV, at the statistical significance of $\approx 2\sigma$. Even though 2.5σ cannot be named a discovery, an effect independently obtained within very similar mass ranges by four project working on two biggest accelerators in the world may give hope that some new particle has been observed.

Even though the experimental results are at first interpreted within the standard model, its supersymmetric and other exotic extensions of various kinds can also be tested against the newly reported findings [3]. Following this line of research, in this communication we discuss an R-parity violating minimal supergravity (RpV mSUGRA) model and constrain it by the liberal condition for the lightest Higgs boson mass 120 GeV $\le m_{h^0} \le$ 140 GeV. Also the specific case of $m_{h^0} \approx 125$ GeV is considered.

II. THE MODEL

The R-parity is a multiplicative quantum number defined as $R = (-1)^{2s+3(b-\ell)}$ and implies stability of the lightest supersymmetric particle. In this paper, following Ref. [4], we adopt the so-called generalized baryon parity in the form of a discrete Z_3 symmetry $B_3 = R_3 L_3$ which ensures the stability of the proton and lack of unwanted dimension-5 operators. In short, R is equal to $+1$ for ordinary particles, and $R = -1$ for supersymmetric partners, and this R is usually assumed to be conserved in interactions. This assumption, however, is based mainly on our will to exclude lepton and baryon number violating processes, which has not been observed in the low-energy regime. Notice, that the generation lepton numbers ℓ_e, ℓ_μ, and ℓ_τ, also conserved in the standard model, are broken in the neutrino oscillations. There is in fact no underlying principle which forbids breaking of ℓ or b. The baryon number violation is highly constrained by the proton decay, but the lepton number violation may occur at high energies. In general supersymmetric models one often discusses the possibility of having the R-parity violating terms, properly suppressed, in the theory. These are the so-called R–parity violating models.

We perform the calculations within the framework described in detail in Ref. [4]. This model takes into account full dependence of the mass matrices and renormalization group equations on the R–parity violating couplings. We define it below by quoting the expressions for the super-

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potential and soft supersymmetry breaking Lagrangian. Next, we discuss the free parameters of the model, and the Higgs sector.

The interactions are defined by the superpotential, which consists of the R–parity conserving (RpC) and violating part

$$W = W_{\rm RpC} + W_{\rm RpV}, \tag{1}$$

where

$$\begin{aligned} W_{\rm RpC} &= \epsilon_{ab}\Big[(\mathbf{Y}_E)_{ij} L_i^a H_d^b \bar{E}_j + (\mathbf{Y}_D)_{ij} Q_i^{ax} H_d^b \bar{D}_{jx} \\ &+ (\mathbf{Y}_U)_{ij} Q_i^{ax} H_u^b \bar{U}_{jx} - \mu H_d^a H_u^b\Big], \qquad (2)\\ W_{\rm RpV} &= \epsilon_{ab}\left[\frac{1}{2}(\mathbf{\Lambda}_{E^k})_{ij} L_i^a L_j^b \bar{E}_k + (\mathbf{\Lambda}_{D^k})_{ij} L_i^a Q_j^{xb} \bar{D}_{kx}\right]. \qquad (3) \end{aligned}$$

Here $\mathbf{Y}$'s are the 3×3 trilinear Yukawa-like couplings, μ the bilinear Higgs coupling, and $(\mathbf{\Lambda})$ and $(\kappa^{\mathbf{i}})$ are the R-parity violating trilinear and bilinear terms. L and Q denote the $SU(2)$ left-handed doublets, while $\bar{E}$, $\bar{U}$ and $\bar{D}$ are the right-handed lepton, up-quark and down-quark $SU(2)$ singlets, respectively. H_d and H_u mean two Higgs doublets. We have introduced color indices $x, y, z = 1, 2, 3$, generation indices $i, j, k = 1, 2, 3 = e, \mu, \tau$ and the $SU(2)$ gauge indices $a, b = 1, 2$.

The supersymmetry is not observed in the regime of energies accessible to our experiments, therefore it must be broken at some point. A convenient method to take this fact into account is to introduce explicit terms, which break supersymmetry in a soft way, ie., they do not suffer from ultraviolet divergencies. We add them in the form of a scalar Lagrangian [4],

$$\begin{aligned} -\mathcal{L} &= m_{H_d}^2 h_d^\dagger h_d + m_{H_u}^2 h_u^\dagger h_u + l^\dagger(\mathbf{m}_L^2) l \qquad (4)\\ &+ {l_i}^\dagger(\mathbf{m}_{L_i H_d}^2) h_d + h_d^\dagger(\mathbf{m}_{H_d L_i}^2) l_i \\ &+ q^\dagger(\mathbf{m}_Q^2) q + e(\mathbf{m}_E^2) e^\dagger + d(\mathbf{m}_D^2) d^\dagger + u(\mathbf{m}_U^2) u^\dagger \\ &+ \frac{1}{2}\left(M_1 \tilde{B}^\dagger \tilde{B} + M_2 \tilde{W_i}^\dagger \tilde{W^i} + M_3 \tilde{g_\alpha}^\dagger \tilde{g^\alpha} + h.c.\right) \\ &+ [(\mathbf{A}_E)_{ij} l_i h_d e_j + (\mathbf{A}_D)_{ij} q_i h_d d_j + (\mathbf{A}_U)_{ij} q_i h_u u_j \\ &\quad - B h_d h_u + \text{h.c.}] \\ &+ [(\mathbf{A}_{E^k})_{ij} l_i l_j e_k + (\mathbf{A}_{D^k})_{ij} l_i q_j d_k + (\mathbf{A}_{U^i})_{jk} u_i d_j d_k \\ &\quad - D_i l_i h_u + \text{h.c.}], \end{aligned}$$

where the lower case letter denotes the scalar part of the respective superfield. M_i are the gaugino masses, and $\mathbf{A}$ (B, D_i) are the soft supersymmetry breaking equivalents of the trilinear (bilinear) couplings from the superpotential.

A. Free parameters

One of the weaknesses of the supersymmetric models is their enormous number of free parameters, which easily may exceed 100. This lowers significantly their predictive power. Therefore it is a custom approach to impose certain boundary conditions, which allow in turn to *derive* other unknown parameters. One may either start with certain known values at low energies and evaluate the values of other parameters at higher energies, or assume, along the Grand Unified Theories (GUT) line of thinking, common values at the unification scale and evaluate them down. In both cases the renormalization group equations (RGE) are used. We follow the top-down approach by assuming the following:

- we introduce a common mass m_0 for all the scalars at the GUT scale $m_{\rm GUT} \approx 1.2 \times 10^{16}$ GeV,
- we introduce a similar common mass $m_{1/2}$ for all the fermions at the GUT scale,
- we set all the trilinear soft supersymmetry breaking couplings $\mathbf{A}$ to be proportional to the respective Yukawa couplings with a common factor A_0, $\mathbf{A}_i = A_0 \mathbf{Y}_i$ at $m_{\rm GUT}$.

The only couplings which we allow to evolve freely, are the RpV $\mathbf{\Lambda}$'s, which are set to a common value Λ_0 at m_Z and are being modified by the RGE running only. The reason for this is, that we want to keep them non-zero, but on the other hand their influence at the low scale must be small. In the first part of this presentation we will fix $\Lambda_0 = 10^{-4}$, which assures only small admixture of the RpV interactions. Later, we discuss the impact of Λ_0 on the results for certain set of input parameters. (For a discussion of the Λ's impact on the RGE running see, eg., Ref. [5]).

There are two remaining free parameters in the model, one describing the ratio of the vacuum expectation values of the two Higgs doublets $\tan\beta = v_u/v_d$, the other being the sign of the Higgs self-coupling constant, sgn(μ), which gives altogether only six free parameters. In this calculations we have kept μ positive, and fixed Λ_0, so the resultant parameter space to analyze is four dimensional.

It is also a common practice to restrict the calculations to the third family of quarks and leptons only, which is supposed to give the dominant contributions. Since this issue is difficult to keep under control, we keep dependence on all three families. Also, unlike the Authors of Ref. [4], we keep the full dependence on all the RpV couplings.

B. The Higgs sector

The procedure of finding the minimum for the scalar potential is quite involving. The equations one has to solve in this model are given in Ref. [4], however, the numerical procedure used by us differs slightly from the one presented in the cited paper.

The goal is to find the values of μ, κ_i, B, and D_i, as well as the five vacuum expectation values $v_{u,d,1,2,3}$ of the two Higgs bosons and three sneutrinos. The initial

values for the vev's are $v_u = v\sin\beta$, $v_d = v\cos\beta$, $v_i = 0$, where $v^2 = (246\ \mathrm{GeV})^2$. We start by setting

$$\mu = \kappa_i = B = D_i = 0 \tag{5}$$

and evaluating g_i, $\mathbf{Y}_{U,D,E}$, and $\mathbf{\Lambda}_{D,E}$ to the m_{GUT} scale. There we impose the GUT unification conditions and run everything down back to the m_Z scale. In this first iteration the best minimization scale for the scalar potential

$$q_{\min} = \sqrt{[(\mathbf{m}_U^2)_{33}]^{1/2}[(\mathbf{m}_Q^2)_{33}]^{1/2}} \tag{6}$$

is calculated. At this scale initial values of μ and B are found, according to the relations

$$\begin{aligned} |\mu|^2 &= \frac{m_{H_d}^2 - m_{H_u}^2\tan^2\beta}{\tan^2\beta - 1} - \frac{M_Z^2}{2}, && (7)\\ B &= \frac{\sin 2\beta}{2}(m_{H_d}^2 - m_{H_u}^2 + 2|\mu|^2). && (8)\end{aligned}$$

Next, a RGE run is performed from $q_{\min}$ to m_Z, but this time the non-zero values of μ and B generate non-zero values for the κ_i and D_i, providing starting point for the next iteration. The second iteration repeats the same steps as the first one, with the exception that now all μ, κ_i, B, and D_i contribute to the RGE running. Getting back to the (new) $q_{\min}$ scale, we solve for μ, B, and v_i using the loop-corrected equations

$$\begin{aligned} |\mu|^2 &= \frac{1}{\tan^2\beta - 1}\Bigg\{\Bigg[m_{H_d}^2 + \mathbf{m}_{L_iH_d}^2\frac{v_i}{v_d} + \kappa_i^*\mu\frac{v_i}{v_d}\Bigg] \\ &\quad - \Bigg[m_{H_u}^2 + |\kappa_i|^2 - \frac{1}{2}(g^2+g_2^2)v_i^2 - D_i\,\frac{v_i}{v_u}\Bigg]\tan^2\beta\Bigg\} \\ &\quad - \frac{M_Z^2}{2}, && (9)\\ B &= \frac{\sin 2\beta}{2}\Big[(m_{H_d}^2 - m_{H_u}^2 + 2|\mu|^2 + |\kappa_i|^2) \\ &\qquad + (\mathbf{m}_{L_iH_d}^2 + \kappa_i^*\mu)\frac{v_i}{v_d} - D_i\,\frac{v_i}{v_u}\Big], && (10)\end{aligned}$$

and the so-called tadpole equations for the sneutrino vev's, which explicitely read

$$\begin{aligned} v_1[(\mathbf{m}_L^2)_{11} + |\kappa_1|^2 + D'] + v_2[(\mathbf{m}_L^2)_{21} + \kappa_1\kappa_2^*] + v_3[(\mathbf{m}_L^2)_{31} + \kappa_1\kappa_3^*] &= -[\mathbf{m}_{H_dL_1}^2 + \mu^*\kappa_1]v_d + D_1v_u,\\ v_1[(\mathbf{m}_L^2)_{12} + \kappa_2\kappa_1^*] + v_2[(\mathbf{m}_L^2)_{22} + |\kappa_2|^2 + D'] + v_3[(\mathbf{m}_L^2)_{32} + \kappa_2\kappa_3^*] &= -[\mathbf{m}_{H_dL_2}^2 + \mu^*\kappa_2]v_d + D_2v_u, \qquad (11)\\ v_1[(\mathbf{m}_L^2)_{13} + \kappa_3\kappa_1^*] + v_2[(\mathbf{m}_L^2)_{23} + \kappa_3\kappa_2^*] + v_3[(\mathbf{m}_L^2)_{33} + |\kappa_3|^2 + D'] &= -[\mathbf{m}_{H_dL_3}^2 + \mu^*\kappa_3]v_d + D_3v_u,\end{aligned}$$

where $D' = M_Z^2\frac{\cos 2\beta}{2} + (g^2+g_2^2)\frac{\sin^2\beta}{2}(v^2 - v_u^2 - v_d^2)$. This set of three equations can be easily solved and we get

$$v_i = \frac{\det W_i}{\det W}, \qquad i = 1,2,3, \tag{12}$$

where

$$W = \begin{pmatrix} (\mathbf{m}_L^2)_{11} + |\kappa_1|^2 + D' & (\mathbf{m}_L^2)_{21} + \kappa_1\kappa_2^* & (\mathbf{m}_L^2)_{31} + \kappa_1\kappa_3^* \\ (\mathbf{m}_L^2)_{12} + \kappa_2\kappa_1^* & (\mathbf{m}_L^2)_{22} + |\kappa_2|^2 + D' & (\mathbf{m}_L^2)_{32} + \kappa_2\kappa_3^* \\ (\mathbf{m}_L^2)_{13} + \kappa_3\kappa_1^* & (\mathbf{m}_L^2)_{23} + \kappa_3\kappa_2^* & (\mathbf{m}_L^2)_{33} + |\kappa_3|^2 + D' \end{pmatrix}, \tag{13}$$

and W_i can be obtained from W by replacing the i-th column with

$$\begin{pmatrix} -[\mathbf{m}_{H_dL_1}^2 + \mu^*\kappa_1]v_d + D_1v_u \\ -[\mathbf{m}_{H_dL_2}^2 + \mu^*\kappa_2]v_d + D_2v_u \\ -[\mathbf{m}_{H_dL_3}^2 + \mu^*\kappa_3]v_d + D_3v_u \end{pmatrix}. \tag{14}$$

The equations (9)–(11) are solved subsequently until convergence and self-consistency of the results is obtained. After this procedure we add also the dominant radiative corrections [6], and get back to the m_Z scale to obtain the mass spectrum of the model.

For the details of the mass matrices which need to be diagonalized see Ref. [4].

III. CONSTRAINING THE MASS SPECTRUM

Not all initial parameters result in an acceptable mass spectrum. One may impose several different constraints to test the model. The problem, however, is in the fact that the available experimental data are in most cases not confirmed in other experiments, not to mention that they are very model dependent. Therefore caution is needed before such constraints will be imposed.

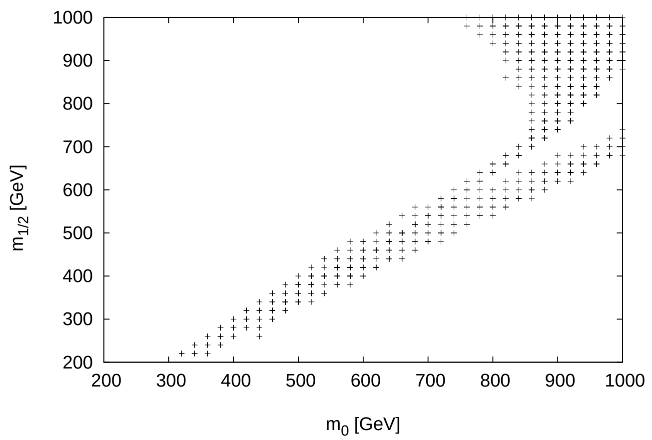

FIG. 1: Solutions for $\tan\beta = 5$. For each point there is an 200 GeV $< A <$ 1000 GeV such that the mass of lightest Higgs boson is in the region 120–140 GeV.

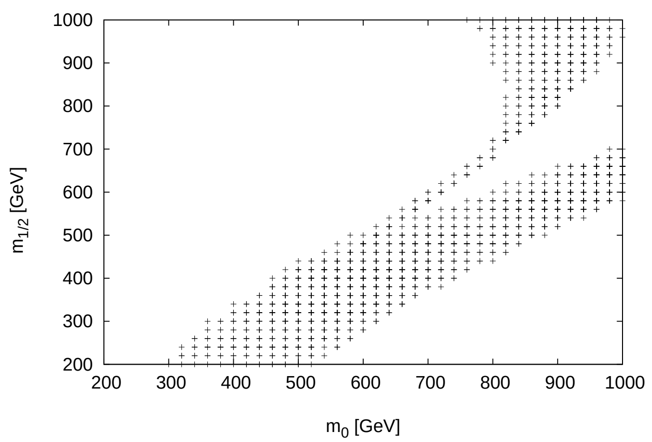

FIG. 2: Like Fig. 1 but for $\tan\beta = 10$.

A. The (120–140) GeV Higgs boson

First, we are going to check whether the recently suggested 120 GeV $< m_{h^0} <$ 140 GeV may be obtained within the described model. The only additional constraints that we have used are the mass limits for different particles, as published by the Particle Data Group in 2010. They read [7]: $m_{\tilde{\chi}_1^0} > 46$ GeV, $m_{\tilde{\chi}_2^0} > 62$ GeV, $m_{\tilde{\chi}_3^0} > 100$ GeV, $m_{\tilde{\chi}_4^0} > 116$ GeV, $m_{\tilde{\chi}_1^\pm} > 94$ GeV, $m_{\tilde{\chi}_2^\pm} > 94$ GeV, $m_{\tilde{e}} > 107$ GeV, $m_{\tilde{\mu}} > 94$ GeV, $m_{\tilde{\tau}} >$ 82 GeV, $m_{\tilde{q}} > 379$ GeV, $m_{\tilde{g}} > 308$ GeV.

We have performed a scan over the whole parameter space given by the following ranges: 200 GeV $\leq m_{0,1/2} \leq$ 1000 GeV with step of 20 GeV, $5 \leq \tan\beta \leq 40$ with step 5, 200 GeV $\leq A_0 \leq$ 1000 GeV with step 100. During this scan we have kept $\mu > 0$ and a fixed $\Lambda_0 = 10^{-4}$. For each point the mass spectrum was calculated and confronted with the imposed constraints.

The results are presented in Figs. 1–8. There is a sep-

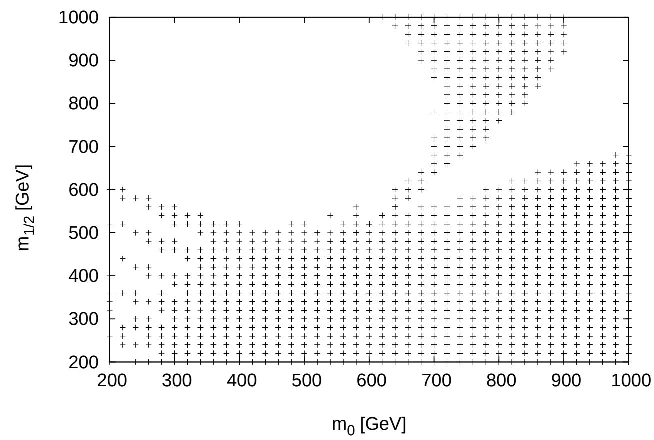

FIG. 3: Like Fig. 1 but for $\tan\beta = 15$.

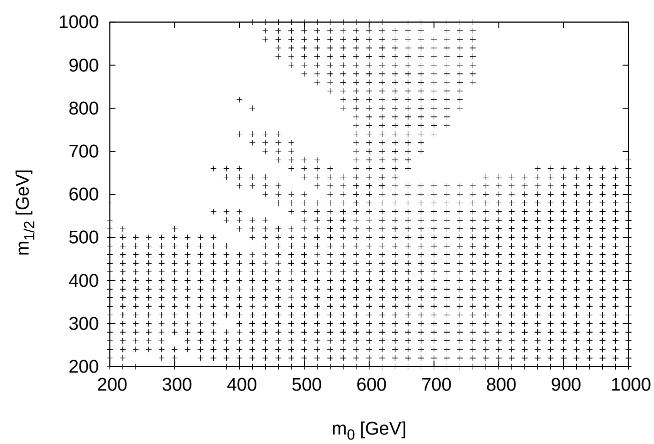

FIG. 4: Like Fig. 1 but for $\tan\beta = 20$.

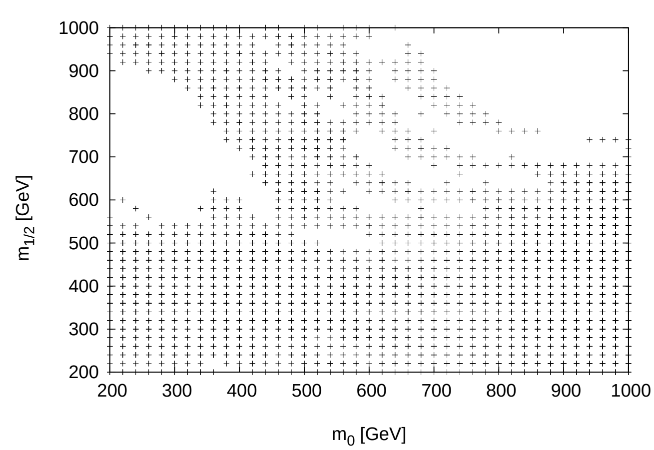

FIG. 5: Like Fig. 1 but for $\tan\beta = 25$.

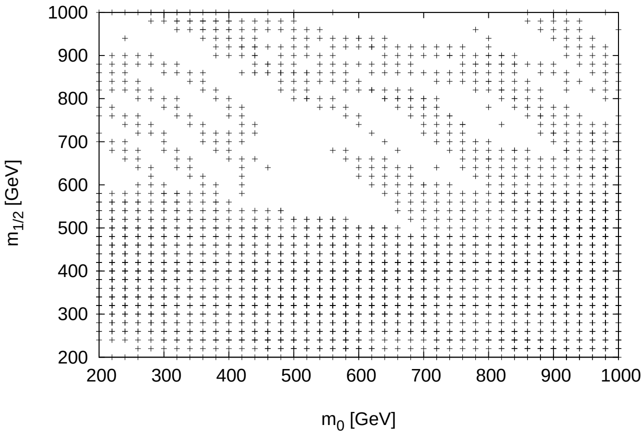

FIG. 6: Like Fig. 1 but for $\tan\beta = 30$.

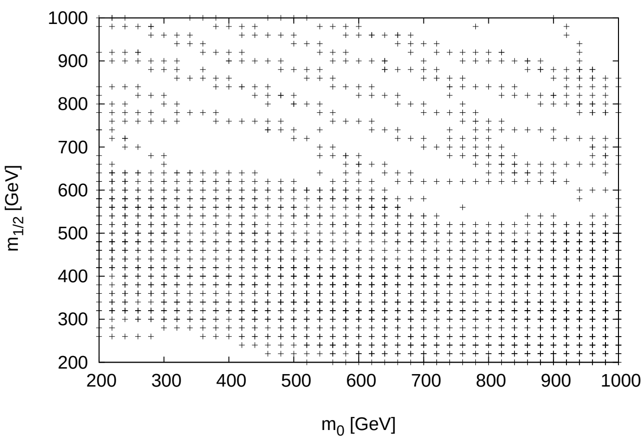

FIG. 7: Like Fig. 1 but for $\tan\beta = 35$.

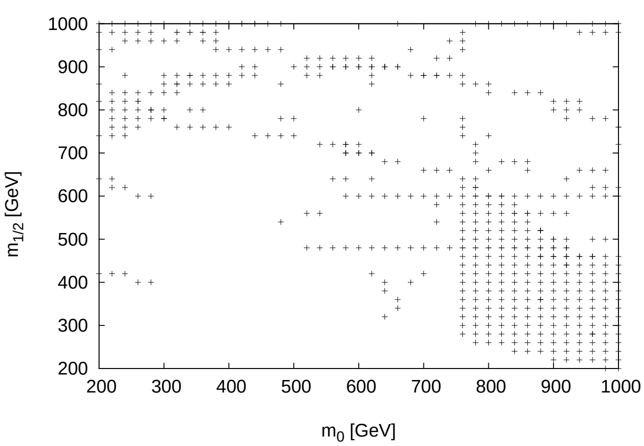

FIG. 8: Like Fig. 1 but for $\tan\beta = 40$. For such high value the model breaks down and the results are not reliable.

arate diagram in the $m_0 - m_{1/2}$ plane for each $\tan\beta = 5, 10, ..., 40$. Every point on these diagrams says, that for certain values of m_0, $m_{1/2}$, and $\tan\beta$ there is an A_0 between 200 GeV and 1000 GeV for which m_{h^0} is between 120 GeV and 140 GeV. Therefore Figs. 1–8 represent the ranges of free parameters, for which the model is compatible with the newest experimental suggestions within error margins.

One sees that for small values of $\tan\beta \leq 10$ the parameter range is quite constrained. For higher values of $\tan\beta$ the common fermion mass $m_{1/2}$ is preferred to be below roughly 600 GeV. A characteristic feature of the model is presented in Fig. 8, ie., that it breaks down for $\tan\beta \approx 40$. This is because for such high values the bottom and tau Yukawa couplings tend to obtain unacceptably high values during the RGE running. Similarly, too small values of $\tan\beta \leq 2$ make the top Yukawa coupling explode.

B. The 125 GeV Higgs boson

If we assume, according to the newest data, the lightest Higgs boson mass to be centered around 125 GeV, the allowed parameter space shrinks drastically. First, let us allow for a 5 GeV spread in the lightest Higgs boson mass. On Fig. 9 the points corresponding to $m_{h^0} = (125 \pm 2.5)$ GeV are presented. As a reference, we give the whole list in Tab. I. If we narrow our field of interest to the, say, $(125 - 126)$ GeV region only, we end up with the parameter space listed in Tab. II. It is apparent, that higher values of A_0 and $\tan\beta$ are favoured. Also, quite often if one of the m's takes smaller value, it is compensated by a high value of the other.

It is worth to comment at this point at the recent constraint on supersymmetry formulated by the LHC collaborations CMS and ATLAS [8, 9]. It excludes the existence of supersymmetric particles with masses below roughly 1 Tev. However, this conclusion has been drawn for the simplest supersymmetric models in which, among others, the R-parity is conserved, and as such do not directly apply to the model discussed here.

C. The Λ_0 dependence

All the calculations have been presented so far for a fixed $\Lambda_0 = 10^{-4}$ parameter. This is just the value for which the RpV effects start to appear, however, their contribution is very small. For $\Lambda_0 = 10^{-5}$ and below, the model essentially becomes R–parity conserving. On the other hand, values of Λ_0 of the order of $10^{-2} - 10^{-1}$ have a very big impact on the results, often throwing the mass spectrum out of the allowed ranges. There is therefore a rather modest region of the Λ_0 parameters in which the model is still physically acceptable, and at the same time the RpV contributions are not marginal.

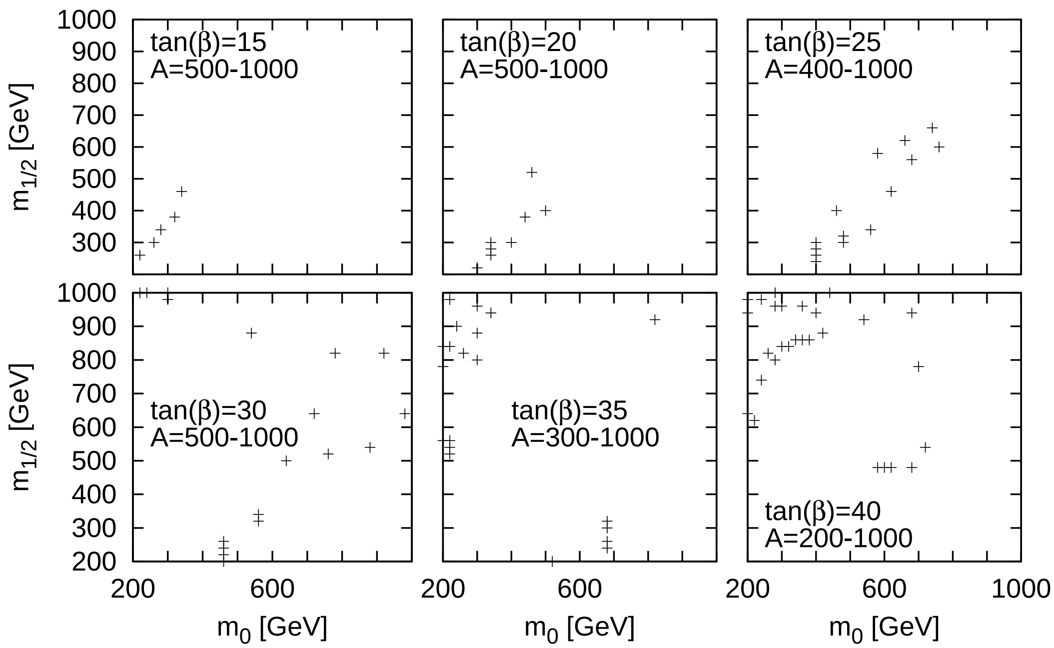

FIG. 9: Parameter space of the mSUGRA model constrained by the condition $m_{h^0} = (125 \pm 2.5)$ GeV.

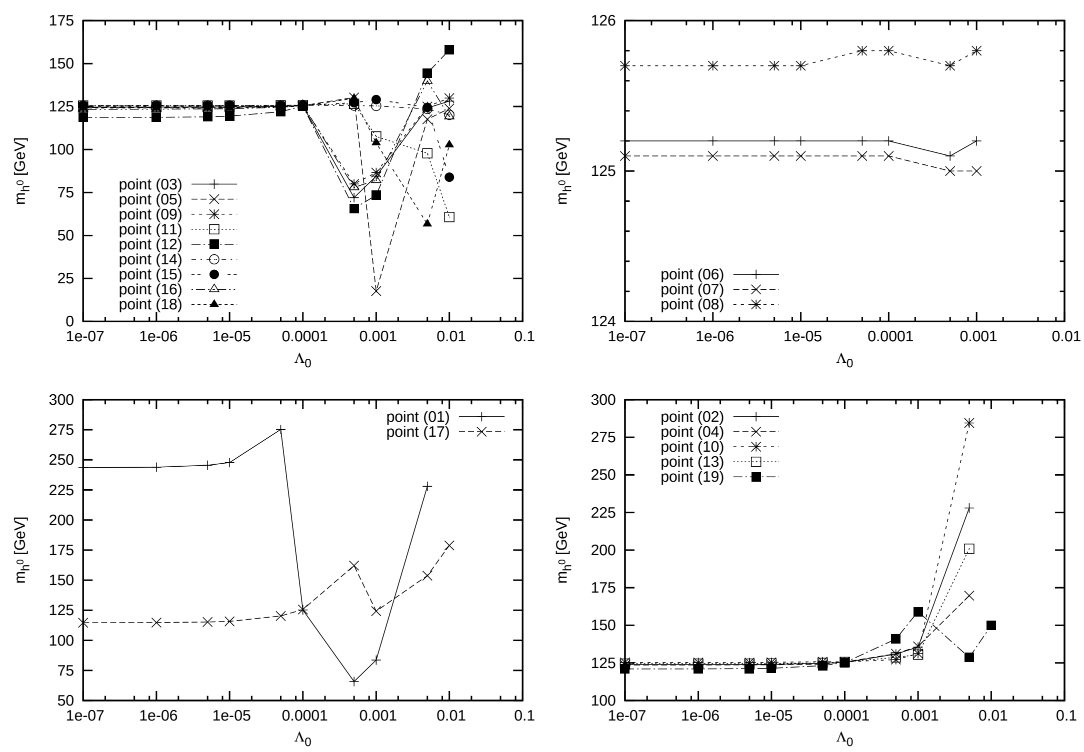

FIG. 10: The Λ_0 dependence of the lightest Higgs boson mass for candidate points listed in Tab. II.

TABLE I: List of free parameters of the model for which $m_{h^0} = (125.5 \pm 2.5)$ GeV (cf. Fig. 9). Here, $\mu > 0$ and $\Lambda_0 = 10^{-5}$.

A_0	m_0	$m_{1/2}$	$\tan\beta$	m_{h^0}	A_0	m_0	$m_{1/2}$	$\tan\beta$	m_{h^0}
200	720	540	40	123.7	700	260	300	15	125.8
200	700	780	40	125.2	700	400	300	20	126.1
200	680	940	40	123.0	700	560	340	25	127.0
300	520	200	35	127.4	700	300	1000	30	124.3
300	220	620	40	123.2	700	540	880	30	123.4
300	200	640	40	124.9	700	720	640	30	125.3
400	460	200	30	126.8	700	760	520	30	123.4
400	460	220	30	126.0	700	240	900	35	124.2
400	460	240	30	126.4	700	300	880	35	126.7
400	460	260	30	127.3	700	300	840	40	126.9
400	680	240	35	124.7	700	320	840	40	123.2
400	680	260	35	123.1	700	340	860	40	127.0
400	680	300	35	124.3	700	360	860	40	124.7
400	680	320	35	126.9	700	380	860	40	124.0
400	280	800	40	126.1	700	420	880	40	126.5
400	260	820	40	126.9	700	200	980	40	124.5
500	300	220	20	126.9	700	240	980	40	125.7
500	400	240	25	123.0	800	280	340	15	123.1
500	400	260	25	122.7	800	440	380	20	123.4
500	400	280	25	122.8	800	620	460	25	124.7
500	400	300	25	125.4	800	580	580	25	126.8
500	560	320	30	122.8	800	220	1000	30	122.8
500	560	340	30	125.6	800	240	1000	30	124.5
500	200	780	35	126.7	800	300	980	30	124.3
500	580	480	40	125.0	800	780	820	30	126.4
500	600	480	40	125.2	800	880	540	30	126.8
500	620	480	40	125.1	800	200	560	35	122.6
500	680	480	40	125.8	800	220	980	35	124.5
500	540	920	40	125.6	800	300	960	35	126.9
500	400	940	40	126.2	800	340	940	35	126.8
500	360	960	40	125.3	800	200	940	40	124.2
500	280	1000	40	127.2	800	280	960	40	123.2
600	220	260	15	123.1	800	300	960	40	125.6
600	340	260	20	123.4	800	440	1000	40	126.7
600	340	280	20	123.6	900	320	380	15	125.8
600	340	300	20	125.5	900	500	400	20	125.0
600	480	300	25	124.9	900	460	520	20	125.8
600	480	320	25	126.1	900	680	560	25	123.9
600	460	400	25	126.3	900	660	620	25	126.7
600	640	500	30	126.0	900	920	820	30	125.6
600	200	840	35	123.6	900	980	640	30	127.3
600	220	840	35	127.3	900	220	520	35	125.7
600	260	820	35	124.5	900	220	540	35	124.4
600	300	800	35	127.3	900	220	560	35	123.3
600	820	920	35	123.3	1000	340	460	15	125.3
600	240	740	40	124.6	1000	760	600	25	124.9
					1000	740	660	25	125.2

TABLE II: List of free parameters of the mSUGRA model for which $m_{h^0} = (125.5 \pm 0.5)$ GeV. Here, $\mu > 0$ and $\Lambda_0 = 10^{-5}$.

point no.	A_0	m_0	$m_{1/2}$	$\tan\beta$	m_{h^0}
(01)	200	700	780	40	125.2
(02)	500	360	960	40	125.3
(03)	500	400	300	25	125.4
(04)	500	540	920	40	125.6
(05)	500	560	340	30	125.6
(06)	500	600	480	40	125.2
(07)	500	620	480	40	125.1
(08)	500	680	480	40	125.8
(09)	600	340	300	20	125.5
(10)	700	240	980	40	125.7
(11)	700	260	300	15	125.8
(12)	700	720	640	30	125.3
(13)	800	300	960	40	125.6
(14)	900	220	520	35	125.7
(15)	900	320	380	15	125.8
(16)	900	460	520	20	125.8
(17)	900	920	820	30	125.6
(18)	1000	340	460	15	125.3
(19)	1000	740	660	25	125.2

Let us now check what is the Λ_0 dependence of the m_{h^0} mass for the 19 candidate points listed in Tab. II. We do not expect all of them to behave in the same way under the change of the Λ_0 parameter, especially that some of them are found in the $\tan\beta = 40$ region, which is in parts numerically unstable. The results are presented in Fig. 10, where we have grouped the points according to their functional dependence on Λ_0. On the lower left hand side pannel two point are presented which seem to be found by accident only, and they yield the wanted lightest Higgs boson mass just for the $\Lambda_0 = 10^{-4}$ value. On the lower right hand side and the upper left hand side pannels we present the category of points, which converge to the correct m_{h^0} value for decresing Λ_0. These points would be the sought solutions in the R–parity conserving model, and also in the RpV case presented here for fine-tuned values of Λ_0. We see that deviations from the $m_{h^0} \approx 125$ GeV may be substantial for Λ_0 greater than few$\times 10^{-4}$, with general tendency to increase (lower right hand side pannel) or decrease/oscillate (upper left hand side pannel). The last, upper right hand side pannel shows three points which very weakly depend on the changing of Λ_0. The solutions obtained form them are stable, regardles in the RpC and RpV regime. These points, surprisingly, also have $\tan\beta = 40$.

IV. CONCLUSIONS

It was interesting to check, that for the typical minimal supergravity model with broken R-parity there is

a quite wide parameter space, for which the mass of the lightest Higgs boson is compatible with the recent Tevatron observations. However, if one refines the constraints using the LHC–7 results, the parameter space shrinks drastically to a set of points roughly given in Tab. II. In this communication we have used a very modest set of constraints on the low-energy spectrum, keeping only the most obvious ones. A more detailed analysis containing a discussion on the Higgs and higssino contributions to the neutrino magnetic moment and 1-loop neutrino masses will be given elsewhere.

We may conclude that, in the way presented above, we have found 17 good candidate points in the RpV mSUGRA model which result in a physically acceptable mass spectrum and are at the same time compatible with the newest Higgs boson searches. There are many more points, like the one numbered (1) and (17), which would also give the desired mass spectrum, but for which a specific fine–tuning of the parametes is necessary.

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